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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: CULLER et al. Examiner: M. Marcheschi  
Serial No.: SN 10/668,410 Group Art Unit: 1755  
Filed: September 23, 2003 Docket No.: 59038US002  
Confirmation No.:  
Title: STRUCTURED ABRASIVE ARTICLE (as amended)

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service, as first class mail, with sufficient postage, in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on April 14, 2005.

By: Rebecca Ralls  
Name: Rebecca Ralls

DECLARATION OF SCOTT R. CULLER

Mail Stop AMENDMENT  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

1. My name is Scott R. Culler, a named inventor on this patent application.
2. I am currently employed by 3M Company as a Division Scientist in the Abrasive Systems Division of 3M. I have been at 3M, in the Abrasive Systems Division, since 1991. I have been working in the area of structured abrasive articles since 1991.
3. Structured abrasive articles have a plurality of composites or protrusions, which comprise abrasive particles and binder, and optional ingredients such as grinding aids, bonded to a backing.
4. As a Division Scientist working in the area of structured abrasive articles, I develop new constructions of structured abrasive articles and modify existing products. I evaluate and experiment with different composite topographies, including shapes and sizes, different abrasive

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particles, different binders and additives, to obtain desirable products based on manufacturing processes and product performance.

5. Also as a Division Scisetist in the Abrasive Systems Division, I test (internally at 3M facilities) structured abrasive articles developed by myself and by others; this testing includes my operating of various hand-held and free-standing grinding machines. I evaluate which abrasive constructions work best in which applications, and modify structured abrasive constructions as needed.

6. As stated above, I am a named inventor on this application. Together with my co-inventors, I determined that structured abrasive articles, having composites or protrusions that have offset peaks whose vector sum does not approach zero, provide improved performance over similar structured abrasive articles having composites or protrusions with offset peaks whose vector sum does approach zero.

7. I prepared and tested two structured abrasive articles, Example D1 and Comparative Example D2. The two examples were prepared in the same manner and had the same composition. The only difference was the shape of the composites or protrusions. For Example D1, the composites or protrusions were similar to that illustrated in FIG. 5 of pending application 10/668,411. For Comparative Example D2, the composites or protrusions were similar to that illustrated in FIGS. 5 and 8 of U.S. Patent No. 5,672,097. The overall height of the composites or protrusions for both examples was approx. 635 micrometers.

8. Example D1 and Comparative Example D2 were prepared by the following method: An abrasive slurry constituted as shown in Table 1 was coated onto an X-weight polyester/cotton backing material at 50 feet/min (15.24 m/min) via a knife coater set to provide a 0.020-inch (0.51 mm) gap. Next, a pattern of shaped composites was imparted to the exposed surface of the slurry coating by nipping a transparent thermoplastic tool having an array of cavities (as described in Table 2) so that the slurry filled the cavities of the tool, thereby imparting the inverse shape of the cavities to the slurry layer. The slurry was then cured to

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create an abrasive article while remaining in the tool by subjecting the exposed side of the transparent tool to UV/visible radiation from two D-bulbs in a series (made by Fusion UV Systems, Inc., Gaithersburg, MD) that were operated at 600 watts/inch (240 watts/cm). The tool was then removed from the abrasive article.

Table 1

Material	General Description	Amount, grams
SR351 resin with 1% Irgacure 369	acrylate resin (from Sartomer Co., Inc., Exton, PA) with photoinitiator, (from Ciba Specialty Chemicals, Basel, Switzerland)	1675
Spec 102 KBF <sub>4</sub>	grinding aid, potassium tetrafluoroborate	800
A-174	silane coupling agent (from OSI Specialties, Wilton, CT)	38
OX-50	amorphous silica, "Aerosil OX 50" (DeGussa AG, Dusseldorf, Germany)	30
ANSI grade 60 ceramic abrasive particles	ceramic abrasive particles, 3M Company, St. Paul, MN, CUBITRON™ 321	5400

Table 2

Example	General Description	Detailed Composite Description
D1	Offset topography having peak vectors not summed to zero	rectangular base having width of 821 micrometers and length of 577 micrometers, pyramid height of 635 micrometers, and a linear pyramid edge profile
Comparative D2	Offset topography, having peak vectors summed to zero	rectangular pyramid base having a base width range 406-711 micrometers with an average base width of 584 micrometers, pyramid height of 635 micrometers, and a linear pyramid edge profile

9. Example D1 and Comparative Example D2 were converted and tested by the following methods:

The abrasive article (prepared as described above) was converted into 6 inch x 264 inch (15 cm x 670 cm) endless abrasive belts by cutting and splicing techniques well known in the art. Since the belt for Example D1 was directional (i.e., all of the offset distal regions were in the

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same place relative to the center point of the base), the "sharp" direction (distal offsets leading) was noted. The comparative belt of Comparative Example D2 had no such directionality.

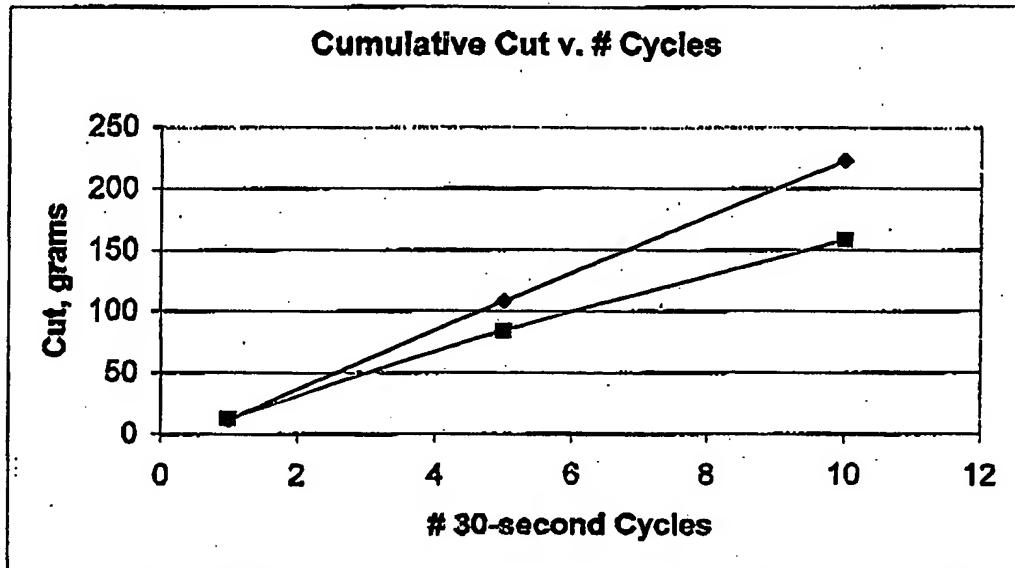
The endless abrasive belts were tested on a low pressure stroke sanding machine (Model "GPMC-6264-5", Grinding & Polishing Machinery Corporation, Indianapolis, IN) with a backup pad contact area of 17 in<sup>2</sup> (109.7 cm<sup>2</sup>). Each endless belt was mounted on the machine (the belt of Example D1 in the "sharp" direction) and tensioned to 75 psi (5.27 kg/cm<sup>2</sup>). Test workpieces were preweighed 3 inch x 16 inch (7.6 cm x 40.6 cm) coupons of type 304 stainless steel. The machine was activated and set to provide a belt speed of 4000 SFPM (1219 m/min). The moving belt was brought into contact with the workpiece by the application of a 26 pound (11.8 kg) load to the backup pad for a 30-second test cycle, during which the backup pad was slowly transversely oscillated to evenly grind the workpiece. The workpiece was weighed between each test cycle and the difference recorded as cut per cycle.

10. The results from the testing of Example D1 and Comparative Example D2 are provided below in Table 3 and the following graph. Example D, with the offset peak vectors not summing to zero, had a higher performance than Comparative Example D2, which had the offset peak vector sum approaching zero.

Table 3  
 Cumulative Cut, grams

Example	1 test cycle	5 test cycles	10 test cycles
D1	12.2	108.4	222.8
Comparative D2	13.3	84.4	158.4

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11. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title XVIII of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: 4/12/2005

  
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Scott R. Culler